USAWC STRATEGY RESEARCH PROJECT

Technology and Power

by

LTC. Rene Francisco Garcia

Gary Maybarduk
Project Advisor

The views expressed in this academic research paper are those of the author and do not necessarily reflect the official policy or position of the U.S. Government, the Department of Defense, or any of its agencies.

U.S. Army War College
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ABSTRACT

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This research paper examines the close relation between technology and power, the latter one being one of the objects of the study of geopolitics. National power, including military power, is affected by perceptions as well as the environment in which it is measured. The growing importance of technology is undeniable, especially when you view it from the geopolitical, globalization and the north – south breach perspectives. A balance should exist between the country's technology and the technology of its Armed Forces. The importance of technology indicates that in the near future, it will be considered as a new factor of national power.

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Starting from the hypothesis "In the current world scenario, technology has evolved as a new factor of national power; it can increase the power of states, and can affect the balance of power among countries", most states are unable to keep pace with the technological and scientific developments applied to the art of war that the big powers have reached and that allow them to influence the decisions of other international actors, mainly smaller states.

The scientific and technological advances of powerful states have enabled them to improve their warfighting capability and influence to impose their will on smaller countries. The conventional weapons developed with the help of modern technology have substituted the great destruction power of nuclear weapons and have demonstrated great accuracy with less devastating consequences.

Technological development in the next years will create intelligent weapons to supplant conventional and nuclear weapons, giving the possessor of this technology the capability to influence the world order. Some countries will reach levels of technological development, which applied to the acquisition of weapons of mass destruction or effect (WMD/E), will increase their power and influence in the world. They will constitute the new threats of the 21st century.

It is opportune to establish that power is changing, not only from a geographical perspective, but also as it is transferred from different states or organizations and alliances, to other countries and emergent powers. This is affecting the international arena and all aspects of political and social life.

In 1961, Argentinean Admiral Celerier saw in electronics the engine of technological revolution when he said: "The employment of atomic energy must bring evidently disorder, just as petroleum transformed the world, the applications of the new techniques are not any less decisive[1]." In the 42 years since this statement, electronics have been decisive in software structuring and hardware administration. This combination of electronics and technology needs important economic support to absorb the costs of experimentation and innovation. United States National Security Advisor, Zbigniew Brzezinski stated that "the base of the American geopolitical expansionist was provided by the quick industrialization of the economy of the country. During World War I, the growing American economic power constituted almost 33 percent of the world's GNP, displacing Great Britain as the major industrial power of the world. This remarkable economic dynamism was impelled by a culture that favored experimentation and innovation."[2]

It is a fact that technology has acquired growing importance in the academic world, and with it, we constantly see the development of new research, seeking answers that surprisingly have their cornerstone in the social sciences. This research project examines the relationship between technology and power from a geopolitical perspective and will emphasize its importance to the strategic level leader.

Technological developments demand the constant upgrade of knowledge, the sources of scientific and technological wealth. When this is achieved, the basic structures of a state become efficient, the economy energizes, resource use is favored, work sources and productivity increase, and the country moves away from underdevelopment.

Therefore, the only way to meet this standard is through planning ahead, foreseeing future needs, and carrying out activities toward a clear objective. Technological development has enabled the studies of future technology as a basic element for planning that governments, institutions, and companies should consider in the short, medium and long term.

THE PROBLEM TODAY

In today's world, technology, a catalytic instrument of globalization, determines the grade of national power and with it, military power. It strengthens the state, determining its relationship with other states. Technology has acquired growing importance in the national and international cultural wealth. This is often written about in books, articles, magazines, and newspapers of importance. However, the topic has not been approached from a point of view that allows the study of technology in connection with power, in such a way that one can analyze its influence on military power as a component of national power.

As a starting point we need to examine what is science, what is technology, how they differ and their relationship. Science may be studied or learned like systematized knowledge, covering general truths or the operation of general laws, especially as obtained and tested through scientific methods. On the other hand, technology refers to the practical application of knowledge, in a particular area, and the practical use of tools, machines and procedures to transform material things to address human necessities. It also refers to the group of technical terms of an industrial activity[3].

Science refers to an intellectual process. It uses an experimental methodology that has empirical demonstrations, verified by means of repetition as a result. Science is less concerned with the practical use of its results and more with the development of general laws; but science and technology are related to each other. Technology can be incorporated as part of the

different components of national power or by itself. In this way, it could be considered a new component of national power.

CONCEPT OF TECHNOLOGY

Technology addresses the methods, procedures and relative uses to a branch of industry as it concerns production methods in software and hardware. Within the software technologies we find the new technologies of information. This technology type refers to "the group of processes and derived products of the new tools (hardware and software) from information and communication channels, related to storage, prosecution and digitized transmission of the information[4]."

We must understand that new technologies of information are what enable the receipt and processing of information of any type. Among them, the Internet is one of the biggest, providing communication and a large quantity of services. Four issues that can summarize the most recent evolution in the world economy and the geopolitical situation are: globalization, the technological revolution, the regionalization of the world, and the increase of the breach between the north and south.

Globalization should be considered a transforming force that is characterized by not having a specific direction nor a predetermined ideal that generates considerable grades of uncertainty. In this context, the fundamental theoretical concepts of the international system are under transformation, generating crashes and confusion among sovereignty - territory – power of the state, in the frame of a new régime of sovereignty that is more complex than what we were used to. Within this framework, the financial and commercial exchanges between countries and blocks will play an important role in the world balance and will be the basis of a new kind of relationship in the international system.

Also, as this globalization process is developed amid the formation of a new world order, the political framework changes at a different speed and a very distant efficiency than that of the economy, the communications, the science, the technology and other development areas. Political changes are not keeping up with technological changes.

The power that resides behind globalization reflects an extended perception that the world is being quickly modeled toward a social space shared and shaped by economic and technological forces. The developments in a region of the world can have deep consequences for the opportunities of individuals' life or communities in the other side of the globe.

It is also useful to know the negative aspects of this new order, such as the uncontrolled flow of goods, and more extended and diverse smuggling. The most caricatured and dramatic example of the inability of states to control the circulation of products is the traffic of drugs.

The contamination and damage to the environment has no frontiers. The hole in the ozone layer, and the global warming effect, which are related to the combustion of fossil material and the deterioration of the big tropical forests, are concern the entire planet. Acid rain and water contamination, particularly in rivers, affect an entire region . In addition, countries and entire regions of the world have to deal with terrorism and the production and potential use of weapons of mass destruction or effects. Globalization brings with it the good with the bad.

On the other hand, the global integration of communications, facilitating the direct interaction and exchange of information among people, institutions and companies, causes the rapid spread of regional or national problems. Likewise, the increase of the speed and masification of the three-dimensional ways of transport (air, land, sea), supported by space technology, are enabling the quick deployment and employment of powerful armed forces anywhere in the globe. However, these same capabilities allow the displacement of political and economic refugees, and simple immigrants, millions can pass from one country to another.

Nevertheless, this it is not the only change that looms in the horizon. In a world highly globalizated and technology dependant, the economic base of nations is suffering changes that go to their very core. The world is subject today to a double globalization process and regionalization, in which the nation-state survives with a diminished capacity for decision. The current tendency in globalization runs the risk of reducing even more the margin of flexibility of states. Evidently, all states will not suffer reduction of their authority the same way, but if it is logical to consider that this represents another factor to consider in the measurement of power in a state.

Technological revolution is the process part of globalization, where knowledge is the greater capital. Countries and their institutions (public and private) should look for ways to achieve success in this new system of relationships. Those countries who fail to realize this relationship, run the risk of being excluded. They should enter this technological revolution, and take advantage of the immense and still growing volume of all kinds of data being generated. The challenge faced by emergent countries is to achieve the development of this capability in the long term. The best and most logic investment is educating future generations. Brazil is an illustrative example of this phenomenon. In spite of being a country with size, population, and strategic position inside the south cone of America, it has not been able to reach its full potential

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because of its economic problems which affect all fields of development and produces a high illiteracy.

Aside of globalization, the other concept tied to this is the regionalization of the world. It is not more than what we see today as the normal tendency to face the challenges of globalization and unipolaritation of the world. It is the formation of different regional blocks. The emergence of the European Community, MERCOSUR, and others, created blocks that acquired their own character or image in the international system. The relationships formerly found among the nation-states, today are driven through these blocks. In this way, every nation is willing to give some of their valuable sovereignty in search of this joint power. In turn, the countries will receive investments and the capability, through this alliance, to influence not in just a single field of action.

Today, in a ridiculous way, the world is divided by the line of the Equator, marking the breach between north and south. This is clearly manifested when we consider the three regions with more economic and military power, North America, Europe, and Asia-Pacific. These are the regions that will compete to enlarge their sphere of vision and influence, while they represent different emphasis from capitalism and free market economy, to their way of impacting the entire world.

In another view of the nation-state, Kenichi Ohmae writes in his book "The End of the Nation-State", that the most important forces that shape the world economy, are "the irreversible effects of technology (in particular, the modern information technology) on the structure of the corporate processes, their costs, value judgments and the consumer's preferences all over the world. In fact, the power of these effects is such that once the information leaves the source there is no turning back. Investments, individuals and information flow with very few obstacles through national frontiers. Technology is part of economic and military power, incorporated in other areas, and affecting the power of a state.

The United States military is placing more emphasis on electronic, command and control systems and artificial intelligence, and proportionally less in other material things. However, sharing technology with allies can become a liability for strategic protection. The more you share, the more vulnerable you become. It can also be said that, the production of weapons and capital expenses in the military sector are done at the expense of other areas, such as social and economic, and often using very scarce resources. The successes of the Japanese electronic industry demonstrate on the other hand, that military investigation is not the only form of achieving technological development.

Zbigniew Brzezinski stated that with the fall of the Soviet Union, America demonstrated that it was economically and technologically much more dynamic that its Cold War rival. Economic decline led to ideological demoralization in the Soviet Union. He also stated that even more important is the fact that the United States has maintained and even enlarged its leadership in the exploitation of the latest scientific advances for military ends, creating an unparalleled military establishment; therefore, the only one with an effective global reach, from a technological point of view. Also, the United States always maintained an important comparative advantage inside information technologies, a key factor from the economic point of view.

CONCEPT OF MILITARY TECHNOLOGY

Technology should serve the user's needs. This technology usually requires lots of personnel dedicated to its maintenance, repair and often, to decipher it. This personnel pool is usually composed, in their vast majority, of highly remunerated technicians, instead of combatants. Often, the newer the technology, the bigger the amount of personnel and time needed to carry out repairs, calibration and maintenance. The positions or field locations are frequently selected to accommodate the technology instead of terrain advantages. The new technology, is without a doubt, more expensive than the technology being replaced; therefore, to improve the quality of the technology usually implies that the necessary elements will not be bought nor necessary technicians be hired. Very often the new technology brings a harnessed unique logistical requirement that creates new demands for combat support capabilities.

Technology should alleviate the commander's workload, providing information to help the decision making process. This is certainly the promise of a new generation of devices of automatic control and electronic sensors. The result, however, is the receipt of large amounts of data. No one can deal with a constant deluge of data. Today, a platoon leader whose platoon is in contact with the enemy, is required to direct fire and control maneuver in his platoon, move to obtain a better position, preserve its combat strength and successfully complete the mission. These are the platoon leader's traditional tasks. The older technology gave the platoon leader the ability to request via radio, artillery fire support, air support, medical evacuation and reinforcements. Thanks to the newest technology, the same platoon leader can receive the advise of his senior commander, leaving him the freedom to choose what to do.

Technology is rarely the complete answer. New systems must interact electronically with older systems, but usually because of cost, different software, and even year of production, this is very difficult to do. Weapon systems are developed as complete packages that can carry out their missions independently. Once acquired, the military should determine how to integrate, in

the best possible way, new systems with existing ones to reach the maximum effect. There is no economy in the world that can afford the complete change of its defense systems often. The best solution is to combine them, limiting the full parameters of the new system's capacities. Recent developments have cleared that new armored personnel carriers cannot ride side by side with the new tanks, new artillery systems exceed the ability of observers to adjust fire and personal bullet proof clothing that protects the soldier is too heavy for combat. The recurring flaw is to use technological parameters developed for one purpose or envornment, but employed in another.

The technology, associated with the creation and production of systems with wartime applicability, has had great developmental progress. It is considered the form whose intensive application is carried to change the development of conflict. This proposal, which according to some historians, started in the period of post-Vietnam introspection, has been denominated the "Revolution in Military Affairs" (RMA)[5] in which the armies that dominate the new technologies will guarantee the possibility to detect and neutralize an opponent of inferior developmental level with precision and speed without precedent.

In a non-distant future, we will see space sensors. Today, munitions can be guided from diverse external sources, so the combined capabilities can attack undetected targets. New, high precision maps will be developed with control systems with the capability to send and receive data to platforms, sensors and weapons, transmitting an integral image of the battlefield.

These new systems prove right those in favor of the RMA. The proponents of RMA say that front lines will disappear and opponents will fight throughout the battlefield destroying critical points of command and control systems, logistical support and communications nodes. International human rights concerns, minimizing casualties, environment concerns, and the development of non-lethal weapons, will make war almost painless, with hardly any human costs. It will be a war against machines, not men. Detractors of RMA express that military technology offers new possibilities to destroy and to be protected, but in any case it will not change the nature of the war.

CONCEPT OF POWER

Power, just as gravity or electricity, is only manifested through its effects; it has always been much easier to describe its consequences than to identify its nature and foundation. In the Book of the National Defense of Chile[6] (equivalent to United States National Military Strategy), national power is defined as the "group of material and spiritual factors that grant the Nation the capability to express its will to get or maintain national objectives, even under adverse

situations. The instruments of national power are the economic, diplomatic, social and military factors. All should be developed harmoniously." Spiritual factors stand out in this definition of national power, understanding that it is not always easy to quantify personal feelings or emotions. According to the Chilean Army War College, national power is defined as "the condition, capacity or situation that a state possesses - when all of its resources and forces are gathered - to impose its will and to influence the behavior of others, or to avoid what is considered objectionable or prejudicial."

Brazilian General Meira Mattos, author of several history and geopolitics books and an authority in geopolitical thought, describes national power as "the sum of material resources or psychological values that a nation possesses, keeping in mind the objectives to reach or to preserve". In this definition, General Mattos incorporates subjective elements such as psychological values as they relate to national objectives.

CLASSIFICATION OF POWER

According to Chilean Doctrine, there are several factors of power. These are the political, military, economic, moral, collective, geophysical and geohuman. It is time to add the power of knowledge and information, which associated with current technological power, will contribute to form the contents of conscience (teaching, publicity, etc.).

Morgenthau distinguishes two groups of elements of national power: "those that are relatively stable and those that are subjected to constant change". Time becomes a relevant aspect in the measurement of power. The elements that he postulates are Geography, Natural Resources, Industrial Capacity, Military Readiness, Population, National Character, National Morals, Quality of Diplomacy and Quality of the Government. As far as technology is concerned, he divides it in two facets: Industrial Capacity and Military Readiness.

Morgenthau goes on to state that "the technology of modern war, transportation and communications has made the development of heavy industries an indispensable element of national power. Since victory in modern wars depends on the quantity and quality of highways, railroads, trucks, ships, airplanes, and tanks, the competition for power among nations becomes a competition thoroughly for the production of bigger, better and more abundant war implements. The quality and productive capacity of the industrial plants, the know-how, the ability of engineers, the inventive genius of investigators, and organizational management, are the factors that affect the industrial capacity of a nation and by extension, its power.

Brzezinski refers to the different dimensions of power presenting technology, communications, and information, as well as trade and finances. His view is that the United

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States "has supremacy in the four decisive environments of global power, in the military and global reach, and in the economic as the main locomotive of global growth. In spite of the fact that in some aspects Japan and Germany don't enjoy the rest of the attributes of global power, technologically, they maintain a position of global leadership in innovation. In spite of a certain grade of coarseness, they enjoy an attractiveness without precedent, especially among the world youth. The United States has political influence unlike any other nation. However, nobody can deny that the same military, economic and cultural powers include elements of technology, which are just as important as geographical and human factors. These give decisive strategic stature and political power to give stability to a country.

ANALYSIS OF THE SITUATION

Military and geopolitical authors, economists, sociologists, and political scientists agree on the growing importance of technology in daily life and society, within a country, and in relationships among states. The other ones are globalization, the regionalization of the world, and the widening of the breach between the north and the south. Therefore, the more technology in a country, the larger the influence it has with other states.

We can also say that there is a direct relationship between technology and military technology. Years ago, we obtained technological development through military technology; today that is not the case. Civilian technology competes with military technology; both supplement and serve each other. The relationship between available technology and military technology is necessary for the balanced development of a country with a low binomial value of security and development. To have large expenses in defense at the expense of the other fields of endeavor will not bring stable growth.

The economy has a direct relationship with technology. If economic resources are not available, you cannot develop technology. In contrast, technological development increases economic resources. This produces dependencies and vulnerabilities developed by power brokers and transnational companies. A country needs to diversify to be more productive, to generate a better economy, so it can assign resources to technological investment. This in turn, allows a country to act in the international environment strongly. Harmony should exist between the available technology in a country and the technology of its Armed Forces.

However, there can be problems between the economy and technology in developing countries. The question is when can one enter this process, since for emergent economies, resources are always scarce. If a country makes a strong investment in technology, there will be other areas not addressed, especially education and health. Tangible examples of countries that

were able to enter this cycle in different times are Russia, Japan, Turkey and Taiwan. They have demonstrated that it is possible to enter the technological arena; the key is knowing when is the best moment and how.

Technology does not only influence the economic and military power of a country. It also affects the social aspect, facilitating the population's education, the geographical aspect, improving infrastructure and the political aspect, providing a quicker and more efficient way to make decisions. Having the appropriate technology allows a country to have the means to possess the maximum quantity of information, to process and use it. Technology acts as a catalytic element in all factors of power.

Military technology is related to the creation and production of systems with applicability to war fighting. Their development, together with the civilian use, has been so exponential that it is believed that little by little it will model a new form of making war. According to Chilean national doctrine, national power is defined as a group of material and spiritual factors, that gathered, are useful to impose the national will or to influence the behavior of others, or likewise to avoid the imposition of the will of another. However, the definition of the Chilean Army War College, fails to consider the non-materials factors that sometimes are more influential.

It is a fact confirmed by several authors that a new era has begun; the end of a bipolar world and the transformation into a unipolar system. The terrorism threat and the asymmetric fight to obtain victory, has been denominated the "Third wave", the "Post Industrial Society" and "the era of the information."

This "era of information" affects the political, social and corporate structures. The general economy has begun to adopt a new structure, more diverse, of easy adaptation, decentralized, with more speed and complexity, and interconnected in such a way that what happens today in New York, will have instant repercussions in Tokyo, London, or Rio. The key concepts of this era according to General Gordon Sullivan will be the following:

- The net will transform the current pattern, increasing the speed and the quantity of the information, producing structural changes in the different corporate organizations, disappearing the administrative intermediate positions, increasing the specialization value and decreasing the size of organizations.
- Simultaneous, continuous and short term production will destroy the myth of the continuous belt, combating this way the competition, reducing the times, expanding productivity and profitability.[7],

It is in this new era that the power of a state is relative to its relationship with other states. This situation still forces the study of behavior of power in its diverse manifestations, because it is the only way that the state can be heard and exercise influence in the world concert. The growing importance of technology has been established by different authors, civilian and military, and from different perspectives. This situation is connected with globalization, the regionalization of the world, and the widening of the breach between the north and the south. The state has to invest in technology, just as it does in all the factors of power. A narrow relationship exists between economy and technology. If a state does not have the economic power, it cannot obtain, or develop technology. With a better economy, it is possible to have a more efficient infrastructure and greater national power. This will allow a state to better manage its relationship with other countries, especially in the handling of a crisis or conflict. This situation forces a state to invest in technology, looking for resources, because with time it will provide for a healthier and better economy.

Today, civilian technology competes with military technology. Both can complement each other and serve each other mutually. The important thing is that a balance should exist between the technology of a country and the technology of its armed forces, since this should be incorporated in the four fields of action and in the different components of national power, for its catalytic essence. Military power has external connotations that affect other applications of national power. The development of military technology has been so powerful that it will revolutionize war fighting, changing doctrines, tactics and strategies. This situation caused a "Revolution in Military Affairs". Toffler classifies this as a new type of war; the "Agrarian War" and the "Industrial War" denominated the "Information War". Other authors call it the "Ciberwar". It is in this sense that the military theoretists are able to find the appropriate doctrinal foundations to act with success in the wars of the future.

Power is one of the objects of study of the geopolitics, for its importance handling international relationships. However, this conceptualization of national power not only embraces material factors, but also spiritual and social, difficult to quantify, to measure power in its global sense.

Some authors include in their measurement of power, diverse material and non-material factors, such as, prestige, honor and the different behaviors according to the state and its population. These subjective values, considered so important, are also inexact, thus making it impossible to consider the measure of power as something definitive.

National power and with it military power, is also affected by international policy and the perceptions of power that other countries might have. In this context, a country operates within a

local, regional, or global environment. So when we want to measure power, it should be clear where is the threat and react accordingly. You can be strong in an environment but be considered weak in another.

Chile, Israel, and Pakistan provide good case studies of the implications of technology. Each country has a total different situation, environment, size, security, international aid, type of government, and geographic location.

CHILE

Located in the west coast of South America, Chile has an area of 286,322 square miles,(only continental soil) and a population of almost 15 million people. With a gross domestic product of US$ 74.123 billion (2001), it expends 2.6 percent in defense spending and 6 percent in education. Education is free and mandatory by law until 12th grade. There is only a 4 percent of illiteracy rate and 31 percent have a university degree[8].

The important changes in the world concerning the balance of power have produced institutional adaptations to which Chile and specially the Chilean Army have not been an exception. A new way of approaching professional tasks allows organizations to adapt themselves in a better fashion to this dynamic process.

Thus, the Army seeks to look into the future and anticipate the possible theatres of operation it could operate in while maintaining its capability and efficiency. All modernization processes bring with it material progress that constitutes the clearest signal of change. However, there is a preceding step, one that accompanies every transformation, constituted by the mental and spiritual disposition reached by the members of the institution to embrace change and become a part of it. Thus, the Chilean Army soldier is more modern, not only because he has a more efficient weapon, but because he is in a position to make use of all the advantages that the weapon provides him. After a process of instruction and training that enables him to apply his skills, he is able to undertake his responsibility in the fulfillment of his principal mission, the defense of the country.

Meanwhile, from an integration perspective within the new world order, the relationship with other world armies provides professional enrichment that the institution values. The exchanges and contacts beyond Chilean frontiers, concerning themes of the most varied nature in the context of military activities, is part of a policy that will continue to flourish in the future.

In the international context, the Chilean Army is an active participant in the Inter-American Defense College and the Inter-American Defense Board, both a part of the Organization of American States. In addition, the Chilean Army is a founding member of the Conference of

American Armies (CAA), and must expand that participation in order to face the challenges of globalization. We will achieve this by more combined exercises, meetings and exchanges in order to be prepared to face the common threats that this century will bring (Narco-terrotism, organized crime, and environmental protection.).

Chile's geographic configuration, with vast desert zones in the north, extensive areas of fiords, ice, channels in the southern part of the country, as well as the distribution of the resulting human resources have been a constant concern that has strongly influenced the organization and characteristics of the Army.

Technological advances diminish the natural disadvantages of large empty areas without communication between them, as well as the economic restrictions and limitations imposed by a climate, which in some cases, is extreme. Because of these factors, Chilean Army modernization must establish a fair balance among the forces that are deployed in peacetime and the capability to achieve the necessary flexibility to face a future conflict somewhere. In this fashion, the Chilean Army seeks to develop a force with deterrence capacity, and if needed fight and obtain victory.

Advances in the scientific arena contribute to self-sufficiency so the national defense industry can satisfy the operational requirements of the Chilean Armed forces, diminishing the dependence on external markets. On the other hand, technological progress allows the generation of projects that increase combat capability. It stimulates basic research through agreements with universities or institutes of higher education, giving to the military industry the applied research it needs. It incorporates into its plans the development of modern weapon systems, in addition to considering educational exchanges with other institutions of the Armed Forces and foreign corporations.

Within this framework, the Tactical Computer Training System[9] (Sistema de Entrenamiento Táctico Computacional -SETAC) employed at the Chilean War College is set and designed by military polytechnic engineers in conjunction with civilian engineers. The aforementioned support system enables the training of commanders and their staffs on the planning and leading at the Brigade and Division levels in combat, through computer simulations. This software can also be used to train civilian organizations to face catastrophic situations and natural disasters.

Likewise, advances in rocketry have crystallized with the rocket "Rayo," which has secured the technology and the entrepreneurial base for the manufacturing of rocket artillery and other types of missiles. This placed the Chilean Army in a privileged position due to the

achievements of its military engineers. The following have also reached a high degree of development:

- The Factories and Metalworks of the Army[10] (Fabricas y Maestranzas del Ejercito, FAMAE) is the principal industry of the institution and an autonomous government company. This company has defined the areas of interest in which its comparative advantages permit it to sustain its development, based on weapons, ammunitions and armored vehicles, that are produced in its own factories, with emphasis on weapons systems, the sale of technological know how, and engineering services.
- The Military Geographic Institute[11] (Instituto Geografico Militar IGM) is an official organization of the State for national map-production. With a high degree of technology and quality, it satisfies the requirements of the different ministries, public divisions, the Armed Forces, mining corporations and private users. At the same time, it undertakes important research activities, for which a great economic effort was expended in acquiring the technology, equipment, instrumental and computer programs of the latest generation, which added to the restructuring of its procedures will satisfy the high demand of its services and products.
- The Research and Control Institute (IDIC) is an official entity of the state for the qualitative reception of materials, equipment, munitions, and other elements acquired abroad as well as in the internal market. It is the official state agency for the quality control of firearms and explosives for civilian use through the Chilean Test Bench. It represents the country on the International Permanent Committee for testing portable weapons and owns various laboratories, responsible for the quality certification of raw materials, products and productive processes in different areas.
- The Chemical Industrial Complex of the Army has the technology for the production of simple base gun powder and propellant for the munitions that FAMAE produces. It is engaged in the development of missile propellants and new conventional munitions.

Education is extremely important in all institutional modernization, as it prepares personnel to exercise command and possess scientific, technological and cultural capabilities appropriate to this world. The clearest example of this is the number of Chilean Army officers attending national and foreign universities, and the recruiting of civilian expert in the area of education so that they can meet the demands of the new methodology. The current educational system impels the different military institutes to have agreements with several academic entities.

For example the Military School, the War College and the Military Polytechnic Academy have agreements with 42 universities and 21 technical institutes.

The results of these military-civilian connections have been truly impressive. Chilean Army officers possess graduate degrees, 6 doctorates, 328 masters in Military Sciences, 93 masters in other sciences and 59 civilians educated in military institutes. In 2002 there were 145 men and women, both Officers and NCOs who completed foreign courses. During 2003 there are already 30 personnel participating in several courses, meanwhile in Chile, there are 81 personnel in courses.

Military Institutes normally seek civilian certification to validate their degrees. The Chilean War College already obtained validation of its master's degree program. Since 1991 the War College and the Military Polytechnic Academy have awarded 13 masters degrees in Military Sciences for military and civilian personnel, and during this year, the Chilean War College will award one degree in "Conflict and International Negotiation."

The Commander in Chief is very interested in post graduate degrees. We have to abandon our "island" vision. It is necessary to know laws, treaties, and industrial processes. This will be a real contribution to the country.

One of the most interesting research programs the Army is working on is rocket propulsion[12]. The first phase of this project ends in 2005. The Military Polytechnic Academy is working with a multidisciplinary group of professionals: military, faculty, and researchers of the Catholic University of Chile, the Factories and Metalworks of the Army (FAMAE), and the Chilean Commission of Nuclear Energy, among others. This is a new endeavor in Chile, where rocket propulsion technology is not well developed because the Armed forces get it from foreign companies. The idea is to be able to develop this technology and have technological independence.

Chile and its Army have understood the importance of technological development to increase power. Chile, has to balance its needs with making good use of economic resources. It highlights the importance of education, with only four percent illiteracy. We can see the collaboration among civilian and military companies, obtaining common uses of jointly developed technologies. Today's correct use of resources will insure a successful future.

ISRAEL

Located in the Middle East, at the eastern end of the Mediterranean Sea, Israel has an area of 13,766 square miles,(including occupied territories) and a population of almost 6,2 million people. With a gross domestic product of US$ 110.4 billion[13] (2000), it expends 4,2

percent in defense spending (plus U.S. Military Assistance of US$ 3 billion a year[14]) and 6 percent in education. Eighty nine percent of the Israelis have completed high school. Israel has only 5 percent illiteracy, and 44 percent have a university degree.

A number of top-level academic institutions were established by the yishuv, the Jewish community in Palestine, even before Israel gained its independence. The first of these was the Technion - Israel Institute of Technology, established in 1924. The Hebrew University of Jerusalem was inaugurated in 1925 and the Weizmann Institute of Science, which came into being in 1946, had its origins in the Sieff Institute, founded in 1934.

Research and development is carried out primarily at the universities. The advancement of basic scientific knowledge is the chief objective of researchers at Israel's universities. In addition to their scientific research activities, the universities continue to play an important role in the country's technological advancement.

Today, 100,000 students are enrolled in Israel's universities, with about 18 percent of all undergraduate students and 50 percent of all Ph.D. candidates specializing in the sciences or medicine. Another 13 percent of all undergraduate students and 10 percent of all graduate students specialize in engineering and architecture. Relative to the size of its labor force, Israel has a significantly larger number of publishing authors in the natural sciences, engineering, agriculture and medicine than any other country.

Altogether, Israel spends $260 million annually on academic research , most of the money coming from the government and administered by the Council for Higher Education, Planning and Budgeting Committee. In addition, research authorities within the universities help faculty members locate, apply for, and administer external research grants. There are at least 300 such sources, including ten large foundations, most of which involve foreign donors and require collaboration with foreign scientists. All in all, grant programs support about 2,000 research projects at an annual cost of $70 million. Israeli researchers also successfully compete for foreign grants and fellowships.

The task of this independent, nonprofit entity, is to assist entrepreneurs to complete their projects and turn them into commercially viable ventures. Today, there are 26 of these entities throughout the country, in which over 200 projects are being conducted. More than 300 projects have already graduated from the program, including 173 which completed their degrees and have continued on their own after their education. Of these, 123 have signed agreements with investment, commercial or strategic partners, with capital investments ranging from $50,000 to $5.2 million.

In the last few years, the leaders of Israel's educational system have come to realize that technological developments have created a gap between modern adult society and the academic environment. Furthermore, if Israel's advanced technological level is to be maintained and enhanced in the future, scientific know-how, and familiarity with modern tools must be introduced to children as early as possible. One outcome has been the introduction of a revolutionary program (Tomorrow 1998) to saturate the schools - from kindergarten upwards - with computers.

Over the past few years, Israel has witnessed an extraordinary boom of industrial productivity. During that time, Israel's GNP has posted an annual growth rate of 5-6 percent, one of the highest in the industrialized world. Among the new factors influencing this are the influx of thousands of highly trained engineers from the former Soviet Union, the development of marketing skills, commercially viable innovations, the decline of the military industries and the application of once-secret military technology to the civilian sector; a significant increase in foreign investments due to the peace process, and the proficiency and relatively low cost (tough this is rapidly changing) of local expertise.

But this development has not been free or easy. Since May 14,1948, Israel has lived in constant danger of invasion and fought several wars. One of the amazing things that you realize when you visit Israel is that their population lives knowing that security is the key to survival when surrounded by dangerous neighbors.

Israel, in the middle of a problematic situation and constant military employment, places great importance in the education of future generations. U.S. Military Assistance is helpful, especially in defense, allowing Israel to channel resources to education, research, and development.

PAKISTAN

Located in South Asia, Pakistan occupies the north-western part of the sub-continent of Indo-Pakistan, shares an eastern border with India and a northeastern border with China. Pakistan has an area of 310,400 square miles and a population of almost 153 million people. With a gross domestic product of US$ 61,3 billion[15] (2000), it expends 4,2 percent of GDP in defense spending and 2,7 percent in education. Only the 33 percent of the men and only the 17 percent of women have completed high school. Pakistan has 71 percent of illiteracy and only 4 percent have a university degree. Pakistan obtained his independence in 1947, just a year before Israel.

At the beginning, Pakistan had no defense industries, and with independence, the country's leadership realized the importance of strong self-reliance in armament production. In 1951, with the help of Royal Ordnance Factories of the United Kingdom, the country established the Pakistan Ordnance Factories. Its commercial slogan, "Weapons mean survival", was a clear indication of a constant struggle for survival.

Pakistan is a poor Third World country faced with the usual problems of rapidly increasing population, sizable government deficits, and heavy dependence on foreign aid, especially from United States and China. In addition, the economy must support a large military. Rapid economic growth, averaging 5 percent – 6 percent over the past decade has helped Pakistan cope with these problems. However, growth slumped to 3 percent in 2000.

The Pakistani education sector is in a critical state of disarray. While substantial investments have been made in building schools, access is not uniform and the overall quality of education remains very poor. Teachers are poorly qualified, frequently hired through political patronage, and receive little in-service training. This systematic failure of the education system stems from issues of both access and quality, seriously hindering Pakistan's future development prospects in areas other than military.

At the present time, Pakistan receives economic aid and transfer of technology from the United States and China, although for different reasons. A strategic position in relation to the War on Terrorism, and an American military presence, might be able to bring some semblance of peace to the region. This could allow Pakistan to apply scarce economic resources to areas like education and health, and to seek the integral development of the country.

Even with examples so different as the three countries mentioned above, we can see that the common denominator for technological development is education and the correct use of today's economic resources is to search for better opportunities in tomorrow's world. War can not be used as a pretext to turn economic resources only to defense; Israel is an example of a successful balance, and Pakistan is not. Certainly peace helps to achieve these goals but defense provides the security umbrella for the development of the country. The balance has to be carefully fulfilled and maintained; the paradise of today maybe the hell of tomorrow. A strategic leader must be able to see much more further than tomorrow.

CONCLUSIONS

Following the Brzezinski's methodology, a sustained strategy should distinguish among the short term perspective (five years), the middle term (until twenty years) and the long term

(more than twenty years). These phases should not be considered as closed compartments but as parts of a continuum.

The dynamic of geopolitical events dictate that power should be measured in the both short and medium terms.

- Diverse nation-states should maintain current policies of achieving a sustained economic growth, since it is the only form to leave underdevelopment and achieve full economic development. To favor ideologies that do not look for economic development, puts national power at risk. The fall of the Soviet Union proved that military power alone can not prevent the collapse of economic power, but on the other hand, economic power will lead to military power, achieved through technology.

- Economic growth should be in harmony in such a way that the economic power of a country brings both growths in infrastructure and education. Countries in the Persian Gulf, despite having natural resources that make them rich and with economic power in a global level, have low education levels and with it illiteracy, placing them among the under developed countries.

- Economic power is the link between all other elements of national power. This constant link produces a general and harmonic development. This situation is important, since a larger economic power can indirectly produce international friction; more if a neighboring country doesn't see this as a benefit to the whole region, but as a threat from a larger or growing power. A way of sustaining economic power is to improve military power.

- Improving military power consists of being more efficient, replacing manpower with technology, and prioritizing quality over quantity. National defense policies must reflect this reality.

- Technology within military power should be guided to obtain more than just better war fighting systems. The "Information War" in combination with the "Non Lethal War" concept, does not seek the death of the opponent; it looks to leave him blind, deaf, silent and paralyzed, without intelligence access to the battlefield.

- Technological advances are only as useful as the people who handle them. More technological advances demand more education, training and specialization, since no state has the luxury of entrusting complex machinery to unskilled labor.

- Economic power acts as a communicating vessel with the rest of the other powers to achieve a harmonic growth of national power. A country should not grow to have

bigger physical space, but should grow to better use its hinterland, its heartland and its lines of communications.

- Today we face a new reality. The old communication ways of the past have been enlarged and today they are all interconnected. All systems have backups and upgrades. This situation establishes the need to preserve and renovate communications means continually. Not to do so risks obsolescence.

- All measurement of military power is relative, since there are material and subjective factors that influence it. A good measurement of power should consider the sum of all those factors and should be endorsed by an independent and international organization.

FINAL WORDS

Technology has improved our quality of life and overall capacity to stay informed instantaneously. If we consider this from the military point of view and for an instant travel in our imagination to the battlefield of the future, it would not be strange to see a battalion or brigade commander, sitting in front of a display replete with screens, full of information and images. We can also visualize that same commander acting outside his span of control, even jumping the normal echelons of command and not allowing subordinates to act with the freedom of action they should have.

Our military careers are based on teaching, mentoring, and leading by example. Both essential elements of education, are present from the junior grades to commanding large formations. In the battlefield, uncertainty defines the line between success or failure of an operation. Our generation, which learned to make decisions without the tools available today, is a generation that can think outside the box and accept risks. But future generations, reliant on definitive information before making a decision, will be the leaders of the future Army. Will the leaders of tomorrow be able to think outside the box and take risks? When do we know if we have too much information? Where is the middle ground?

The logical resolution of countries in development is to invest in education. Today we have to prepare future generations to lead. Poor investments and illogical expenditures of economic resources will cause stagnation of all the state endeavors. During periods of economic growth states must address their needs and set achievable goals. To spend today's resources in fleeting investments that will not produce benefit to the country is dangerous and can bring serious consequences. A good example is the case of Argentina. After a long period

of economic health, Argentina sold most of its federal industries, including those supplying basic services. Once a great world exporter of grain and meat, today Argentineans are starving to death.

At the other side of the spectrum, we have Israel, not big in size but with a huge technological advantage within the region. During the years, we have witnessed the constant threats of Arab neighbors to destroy this Jewish settlement. No coalitions or alliances have been able to defeat the Hagana.

Technology is becoming a source of power for a state to employ just as it does with the instruments of power. Technology bridges the gaps between countries of differing stature and enables the state to reach levels unattainable in the past.

WORD COUNT = 8,479

ENDNOTES

[1] Pierre Celerier, <u>Geopolítica y Geoestrategia</u>, 4th ed. (Buenos Aires, Argentina: Editorial Pleamar, 1994), 2.

[2] Zbigniew Brzezinski, <u>El Gran Tablero Mundial, la Supremacía Estadounidense y sus Imperativos Geoestratégicos</u> (Barcelona, España: Ediciones Paídos, 1998), 13.

[3], Philip B. Gove, ed. <u>Webster's Third New International Dictionary</u>, unbridged. (Springfield, MA: G & C Merriam Company, 1971), 2032, 2348.

[4] A. González et al., <u>Las Nuevas Tecnologías en la Educación</u>, (Santiago, Chile: Editorial ZIG-ZAG, 1999), 23.

[5] William A. Owens, "The Once and Future Revolution in Military Affairs," <u>Joint Force Quarterly</u> 31 (Summer 2002): 55.

[6] Gobierno de Chile, Ministerio de Defensa Nacional, <u>Libro de la Defensa de Chile</u> (Santiago, Chile: Morgan Impresores, 2000), 29.

[7] Gordon R. Sullivan and James M. Dubik, "Cómo se librará la Guerra en la Era de la Información." <u>Military Review</u> 80 (January-February 2000): 90-91.

[8] "Data and Statistics - Chile;" available from <http://www.worldbank.org/data/>; Internet; accessed 13 March 2003.

[9] The Tactical and Operational Training Center (C.E.O.T.A.C.) is the organization in charge of overseeing compliance to military doctrine, computer training and/or computer-assisted training systems application for military administration. It also acts as a research and development organization with respect to the above-mentioned systems (SEOTAC). C.E.O.T.A.C. is presently at the forefront of computer simulation technology, incorporating digital satellite images into its workstations, but fundamentally due to its uniform application in both workstation and PC platforms which means substantially reduced maintenance and updating costs for the equipment being used. The system's merits include not only the simulation of combat situations, but also the necessary flexibility for the development of other applications, such as the Institutional and Organizational Management Training System, which brings the Army into the national development support arena by creating spaces for the training of those organizations responsible in the case of national catastrophes.

[10] "FAMAE;" available from <http://www.famae.cl>; Internet; accessed 20 January 2003.

[11] "Instituto Geográfico Militar;" available from <http://www.igm.cl>; Internet; accessed 20 January 2003.

[12] "Cohetes y Misiles;" available from <http://www.famae.cl/rayo.htm>; Internet; accessed 20 January 2003.

[13] "Data and Statistics – Israel;" available from <http://www.worldbank.org/data/>; Internet; accessed 13 March 2003.

[14] "Defense Spending," <u>Jane's Sentinel Security Assessments</u> (24 June 2002): [database on-line]; available from Jane's International Group; accessed 10 March 2003.

[15] "Data and Statistics – Pakistan;" available from <http://www.worldbank.org/data/>; Internet; accessed 13 March 2003.

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